Anesthetic Decision Making

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Objectives

- Discuss the rationale for general and regional anesthesia
- Discuss the rationale for use and risks of agents used for general anesthesia
- Review the benefits and risks of regional anesthetic techniques

Objectives of General Anesthesia

- Amnesia, loss of consciousness and awareness
- Analgesia
- Elimination of somatic, autonomic and endocrine reflexes
- Skeletal muscle relaxation
- Not “too light”, not “too deep”

General Anesthesia

A Little Bit of This
A Little Bit of That

Hazards of Anesthesia

Anesthesia that is too deep has consequences for patient safety.

On the other hand, anesthesia that is too light has its own hazards – mainly for the surgeons.

The Ideal Anesthetic will

- cause loss of sensation esp. pain.
- cause loss of noxious reflexes.
- induce muscular relaxation.
- induce smooth onset and recovery.
- induce anterograde amnesia.
- cause no systemic amnesia.
- cause no systemic toxicity.
- present no hazard to others.
Drug Selection

◆ Pharmacokinetics
  What the body does to the drug
◆ Pharmacodynamics
  What the drug does to the body

Inhalation Anesthetics
Pharmacokinetics

◆ Absorption from alveoli into pulmonary circulation, distribution to the body and elimination
◆ Will be influenced by blood-gas solubility coefficient, cardiac output and alveolar to venous partial pressure differences
  Desflurane is poorly soluble

Soluble agents exert NO clinical effects until saturation is reached and a partial pressure can be exerted. A poorly soluble drug rapidly begins to exert clinical effects.

High cardiac output rapidly distributes agents into tissues, lowering saturation. More drug will be needed to maintain effects. Vessel rich groups will have increased uptake.

Inhalation Anesthetics
Pharmacodynamics

◆ MAC: lowest concentration of an inhalational anesthetic required to prevent skeletal muscle movement in response to surgical stimulation
  Alteration of neuronal activity
  Interruption of neural transmission

Common Properties

◆ Loss of consciousness
◆ Elimination independent of hepatorenal function
◆ Elimination through pulmonary ventilation
◆ Shift CO2 response curve
◆ Vasodilitation
◆ Increase cerebral blood flow
◆ Some degree of myocardial depression

Inhalation Anesthetics

◆ Nitrous oxide
◆ Desflurane
◆ Sevoflurane

Nitrous Oxide

◆ Most widely used agent-Adjunct
◆ Increases speed of induction
◆ Administered with Oxygen (70/30)
◆ Low potency
**Desflurane (Suprane)**

- Relatively insoluble
- Rapid onset
- Rapid elimination
- Cardiovascular stability
- No hepatotoxicity
- Irritating to airway on induction

**Sevoflurane (Ultane)**

- Relatively insoluble
- Rapid onset
- Rapid elimination
- Cardiac stability: Coronary vasodilator
- Good for induction
- Fluoride metabolite may be problematic with long exposures (renal toxicity)

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**Nursing Implications**

- All agents except N₂O can trigger MH
- All agents are respiratory depressants
  - Oxygen
  - Encouraging CDB
  - HOB elevated
  - Vital sign monitoring/O₂ sat
  - Pain control if only agent used

**Intravenous Anesthetics**

- Induction
- Sedation
- Monitored anesthesia care
- Maintenance of anesthesia

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**Pharmacokinetics**

- Absorption bypassed with IV administration: Rapid onset
- Distribution dependent on organ blood flow (vessel rich groups)
  - Protein binding
  - Volume of distribution
- Liver is major organ of metabolism
- Elimination dependent on volume of distribution

**Pharmacodynamics**

- Age
- Weight
- Sex
- Previous exposure to drugs selected

- As these variables are not controllable by the anesthesia provider, titration to effect guides administration.
### Barbiturates
- Pleasant induction of sleep
- Supplement other agents
- Sole anesthetic for short procedures
- Sedation and amnesia

Methohexital (Brevital) used only for ECT

### Action of Barbiturates
- Respiratory depression
  - Progressive hypercarbia/hypoxemia
- Myocardial depression
  - ↓ cardiac output, BP, PVR
- Sedation “hangover of awakening”
- Histamine release with pentothal

### Etomidate
- Induction agent
- Cardiovascular stability
- Useful in emergency surgery where there is little time to stabilize
- Decreases cerebral blood flow and cerebral oxygen consumption
- Negative effects: myoclonus, hiccoughs, pain on injection, PONV, adrenal suppression

### Propofol (Diprivan)
- Intravenous hypnotic
- Rapid onset of action
- Smooth induction and maintenance
- Rapid awakening without “hangover”
- No PONV—Protective?
- Most popular agent used

### Ketamine
- Dissociative anesthetic
- Profound analgesia
- Used for procedures not requiring muscle relaxation
- IV or IM administration
- Respiratory stimulant
- Stimulates CV system
- Negative: Emergence, Abuse (“Special K”)

### Emergence
Emergence is a phase of unpleasant dreams, confusion, hallucinations, excitement, or irrational behaviour that a patient may pass through when recovering from Ketamine administration.
Nursing actions for IV anesthetics

- Extremely short acting with most effects gone prior to admission to PACU
- If administered for procedures in PACU
  - Respiratory depression
  - Emergence
  - Emergent reactions

Benzodiazepines

- Premedication before surgery
- Induction agents
- Maintenance of anesthesia
- IV sedation
- Supplement to regional/local anesthesia
- Diazepam, Midazolam, Lorazepam

Diazepam

- Preop sedation—especially oral (peak 30-60m)
- Long recovery secondary to T\(\frac{1}{2}\) life
- Large volume of distribution
- Low hepatic clearance
- IM administration unpredictable
- Amnestic effects minimal after oral administration
- Drug crosses the placenta

Midazolam (Versed)

- Induction, maintenance, IV sedation, agitation, supplement to regional, short procedures
- Rapid onset, short T\(\frac{1}{2}\)
- Rapid clearance
- Amnestic agent
- Reversible
- IV/IM/oral administration of IV dose
- Closest to the ideal agent

Lorazepam (Ativan)

- 5-10 times more potent than diazepam
- Moderately protein bound, smaller Vd, shorter T\(\frac{1}{2}\)
- Long sedation-limits use perioperatively
- May be used with ketamine to decrease emergent reactions

Nursing Implications

- Potentiate narcotics
  - ↓ventilatory response
  - ↓BP, SVR, ↑HR, orthostatic changes
- Hemodynamic changes
- Amnestic effects
- Teaching, written materials
- Patient safety
**Benzodiazepine Antagonists**
- Aminophylline, physostigmine and naloxone
- Flumazenil (Romazicon)
- Reverses sedative, amnestic, muscle relaxant, anticonvulsant, anesthetic and respiratory depressant effects of benzos
- 0.4mg to 1.0 mg IV
- Consider risk of N/V and duration of action of benzodiazepine on board

**Narcotics**
- Preop sedation and analgesia
- Intraop induction and maintenance and to blunt autonomic responses
- Postop for pain control

**The Good, Bad and the Ugly**
- Alter perception and response to pain
- Dose-related respiratory depression
- Dose-related cardiovascular effects
- Rigidity of abdominal/thoracic muscles
- Nausea and vomiting

**Narcotics**
- Morphine
- Fentanyl
- Sufentanil
- Alfentanil

Differences in potency
peak duration
T½

<table>
<thead>
<tr>
<th>Drug</th>
<th>Peak (min)</th>
<th>Duration (hours)</th>
<th>T½ (hours)</th>
<th>Important Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>15-30</td>
<td>3-4</td>
<td>3-4</td>
<td>Histamine</td>
</tr>
<tr>
<td>Fentanyl (100x MSO₂)</td>
<td>3-5</td>
<td>1-2</td>
<td>3-4</td>
<td>IV, IM, epidural, patch, oral</td>
</tr>
<tr>
<td>Sufentanil (1000x MSO₂)</td>
<td>5-15</td>
<td>1-2</td>
<td>2-3</td>
<td>IV, epidural, intranasal</td>
</tr>
<tr>
<td>Alfentanil (25x MSO₂)</td>
<td>5-15</td>
<td>0.25</td>
<td>1.3-1.6</td>
<td>N/V common Too short acting</td>
</tr>
</tbody>
</table>

**Nursing Implications**
- Airway
- Ventilation
- Watch use of benzodiazepines
- Titrate additional narcotics
- Nausea and vomiting
Narcotic Antagonists

- Naloxone
- Displaces narcotic from mu receptors by acting as a competitive antagonist
- Peaks almost instantly
- 30-45 minute duration of action
- Reverses respiratory depression and analgesia
- Usual doses 0.1-0.4 mg IV

Muscle Relaxants

- Facilitate endotracheal intubation
- Skeletal muscle relaxation
- Classified as depolarizing or non-depolarizing depending on action at cholinergic receptor site
- Paralysis for mechanical ventilation

Mechanism of Action –

THE IDEAL RELAXANT

- Nondepolarizing
- Rapid onset
- Dose-dependent duration
- No side-effects
- Elimination independent of organ function
- No active or toxic metabolites

Depolarizing Muscle Relaxant

- Succinylcholine
  - Rapid onset (30-60 seconds)
  - Short duration (3-5 minutes)
  - Metabolized by plasma cholinesterase
  - Histamine release
  - Bradycardia
  - Hyperkalemia
  - Myalgias
  - MH trigger
**Depolarization with Succinylcholine**

Depolarizing muscle relaxant (Succinylcholine) → Cholinergic receptor site → Initiation of muscle response

**Non-depolarizing Muscle Relaxants**

- Compete with acetylcholine at the cholinergic receptor site preventing ACh activity
- Agents vary by duration of action, route of elimination, histamine release, vagolytic effects (↑ HR)
- Competitive antagonist means reversibility by changing odds in the competition

**Non-depolarizing Muscle Relaxants**

- Acetylcholine
- Cholinergic receptor site
- Nondepolarizing muscle relaxant

**Reversal of NM Blockade**

- Restoration of NM function by binding to enzyme AChE, allowing levels of ACh to increase
- Change odds in competition to favor ACh
  - Neostigmine

**Reversal of Neuromuscular Blockade**

- Reversal agent
- Acetylcholine
- Cholinergic receptor site
- Nondepolarizing muscle relaxant

**Non-depolarizing Muscle Relaxants Table**

<table>
<thead>
<tr>
<th>Relaxant</th>
<th>Duration of action</th>
<th>Route of elimination</th>
<th>Important info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mivacurium</td>
<td>Short</td>
<td>Plasma cholinesterase</td>
<td>Dose-related histamine release</td>
</tr>
<tr>
<td>Atracurium</td>
<td>Intermediate</td>
<td>Hoffman elimination</td>
<td>Slight histamine release</td>
</tr>
<tr>
<td>Vecuronium</td>
<td>Intermediate</td>
<td>Hepatic</td>
<td>No histamine CV stability</td>
</tr>
<tr>
<td>Rocuronium</td>
<td>Intermediate</td>
<td>Liver</td>
<td>Histamine release ↑ pulmonary VR</td>
</tr>
<tr>
<td>Pancuronium</td>
<td>Long</td>
<td>Renal</td>
<td>Vagolytic ↑HR</td>
</tr>
</tbody>
</table>

**Reversal**

- Must give with an anticholinergic agent to prevent ↓ HR, ↓ BP, salivation and bronchoconstriction 🎨
Factors influencing Reversal

- Is the patient ready?
- Consider renal/hepatic function
- Hypothermic?
- Acid-base alterations?
- Hypokalemic?
- Mycin antibiotics on board?
- Patient to remain intubated?

Balanced Anesthesia
A little bit of this, a little bit of that...

Inhalation Anesthetics
Benzodiazepines
IV anesthetics

Hypnosis

Analgesia
Immobility

Narcotics
Muscle relaxants

Things to Remember

- Patients rarely if ever get one drug
- One drug plus one drug does not equal two drugs clinically
- Remembering drug effects is often the why we do what we do in the PACU/ICU

Regional Anesthesia

Oh, the places you can go with needles!

Local Anesthesia

- Blocks the initiation and transmission of impulses in excitable tissues
- May be applied topically, via infiltration, or injection
- Regional techniques include peripheral nerve blocks, IV regional blocks, spinal, epidural and caudal anesthesia

Advantages of Regional Anesthesia

- Alternative to general anesthesia for some surgical procedures
  - No loss of consciousness
  - Avoids postop “hangover”
  - May decrease need for pain medication
  - Useful if physiologically compromised
  - Less CV compromise
Disadvantages of Regional Anesthesia

- High anxiety in non-sedated patient
- Addition of IV agents may delay recovery
- Limited by surgical site
- Limited by technical aspects
- Limited by length of surgery
- Long block may limit discharge

Pharmacology of Local Anesthetics

- Inhibit nerve conduction by preventing increases in cellular permeability to sodium ions
- Decrease in sodium ions slows cellular depolarization
- No action potential generated, causing a conduction blockade
- Autonomic→Sensory→Motor Blockade

Local Anesthetics

Esters
- Procaine, chloroprocaine, tetracaine, benzocaine
- Metabolized by plasma cholinesterase
- PABA metabolic byproduct causing histamine-type reaction

Amides
- Mepivacaine, lidocaine, prilocaine, bupivcaine, etidocaine, ropivicaine
- Metabolized in the liver
- Rare allergy
- Most commonly used

Local anesthetic selection

- Selection of a specific local anesthetic should be tailored towards specific goals
- Intermediate-acting agents acting agents-lidocaine and lidocaine and mepivicaine (fast onset, shorter duration of action)
- Long-acting agents acting agents- bupivcaine and ropivicaine

Cocaine

- Alkaloid anesthetic
- Unique property of vasoconstriction
- Ideal local for vascular areas: Nasal mucosa
- Metabolized by plasma and liver cholinesterases
Duration of action

- Duration of action will be influenced not just by pharmacology of the agent, but by its use.
- Example: Bupivacaine
  - Intrathecal (spinal)
    - Onset: 5 minutes
    - Lasts: 3–4 hours
  - Brachial plexus block
    - Onset: 20–30 minutes
    - Lasts: 10 hours

Adding epinephrine to the local slows absorption and may prolong block by 50%

No epi in blocks for fingers, toes, penis, nose

Anesthetic Dose

- Calculation requires knowing volume and concentration of medication used.
- Examples:
  - 20 ml of 0.5% lidocaine
    - 0.5% = 5 mg/cc x 20 ml = 100 mg total dose
  - 15 ml of 1% lidocaine
    - 1.0% = 10 mg/ml x 15 ml = 150 mg total dose
  - 10 ml of 0.75% lidocaine

Systemic Toxicity-CV effects

Excessive dose or intravascular injection

- Mild
  - ↑PR interval
  - ↑QRS duration
  - ↓Cardiac output
  - ↓Blood pressure
- Severe
  - ↑↑PR Interval
  - ↑↑QRS duration
  - Sinus bradycardia
  - AV block
  - ↓↓Cardiac output
  - Hypotension
  - Asystole

Systemic Toxicity: CNS effects

Excessive dose or intravascular injection

- Mild
  - Lightheadedness
  - Dizziness
  - Tinnitus
  - Drowsiness
  - Disorientation
- Severe
  - Muscle twitching
  - Tremors
  - Unconsciousness
  - Convulsions
  - Respiratory arrest

Topical Use of Local Anesthetics

- IV insertion (EMLA cream)
- Application to a mucous membrane
  - Oropharynx (Cetacaine, Viscous lidocaine)
  - Nasal (Cocaine)
  - Eye
- Onset dependent on vascularity
- Skin: Up to one hour
- Eye/nasal: Within 5 minutes
Local infiltration
- Sensory blockade with blocking a specific nerve
- Lidocaine intradermally for IV insertion

Peripheral Nerve Block
- Injection of a local anesthetic into or around a specific nerve or group of nerves
- Used to provide intra-operative anesthesia and postoperative analgesia
- Diagnosis and treatment of chronic pain
- Now have increased safety and accuracy with use of ultrasound
- Each block is associated with specific risks

Head and Neck Nerve Blocks
- Cervical plexus
- Neck surgery
  - Retrobulbar
  - Ophthalmic surgery

Upper Extremity Nerve Blocks
- Wrist Block
  - Radial nerve
  - Ulnar nerve
  - Median nerve

Trunk Nerve Blocks
- Intercostal
- Paravertebral
- Stellate ganglion
- Celiac
- Ilioinguinal
- Lumbar sympathetic
- Penile

Lower Extremity Nerve Blocks
- Psoas compartment
- Sciatic
- Lateral femoral cutaneous
- Femoral
- Obturator
- Lumbar plexus
- Ankle
Brachial Plexus Block

- Interscalene approach
- Technique of choice
- Level of 6th vertebra
- Closer to nerves, rapid onset
- Minimal potential for pneumothorax

- Axillary approach
- Distal to elbow procedures only
- Minimal complications

- SuprACLAVicular approach
- Increased risk of pneumothorax
- Allows for minimal dosing
- Rapid onset
- Any position of arm

Ultrasound guided blocks

Nursing Implications

- Determine presence or absence of block
- Protection of extremity
- Capillary refill
- Distal pulses
- Maintain ordered positioning
- Return of motor/sensory function

IV Regional Block (Bier Block)

- Injection of local anesthetic into venous circulation of intended extremity
- Local diffuses into nearby nerves, achieving surgical anesthesia
- May also be used as a sympathetic block for pain

IV Regional Block

- Nursing implications for this block are minimal ASSUMING choice of local matches procedure (>30 minutes) and cuff release occurs slowly.
- Block should be resolved on admission.
- Risk of systemic toxicity exists if tourniquet fails or is released prematurely.

Epidural Anesthesia

- Injection of local anesthetic (+/- narcotic) into epidural space via lumbar or thoracic approach
- Local anesthetics bind to nerve roots as they enter and exist the spinal cord
- Low concentrations block sensory nerves, leaving motor function intact
- Narcotics work by diffusing across the dura, binding to opiate receptors in the substantia gelatinosa
### Advantages of Epidurals
- Segmental anesthesia
- Postop analgesia
- Avoids cardiopulmonary effects of general anesthesia
- Low dosing allows motor function to remain intact while blocking sensory nerves
  - Labor and delivery
  - Postop pain control with ambulation/CDB

### Disadvantages
- Use postop may be limited by hospital resources
- Contraindicated in hypovolemia, local infection, septicemia, hypocoagulability, patient refusal

### Side Effects of Epidurals
- Respiratory depression
- Pruritis
- Nausea and vomiting
- Urinary retention
- Hypotension

### Respiratory Depression
- Secondary to effect of narcotics on the brainstem
- Standing orders for naloxone
- Cancellation of all other pain med orders
- Pulse oximetry

### Pruritis
- Secondary to histamine release-Morphine
- Diphenhydramine, naloxone, dose reduction
- Change narcotic in the infusion to fentanyl

### Nausea and Vomiting
- Secondary to stimulation of CTZ in medulla
- Treatment: Antiemetic-Preferably one with minimal sedation as a side effect
Urinary Retention
- Secondary to sympathetic and sensory blockade of nerves innervating the bladder
- Treatment: Catheterization

Hypotension
- Secondary to excessive dosing of local anesthetic causing sympathetic blockade
- Treatment: usually none required; Fluids

Complications
- Inadvertent intravascular injection
- Accidental subarachnoid puncture (“wet tap”)

Dural Puncture = Spinal Headache
- Caused by a decrease in CSF pressure secondary to a leak of CSF via a dural puncture site
- Frontal or occipital
- Worse with standing
- Nausea, tinnitus, photophobia
- Treatment: Blood patch

Epidural Blood Patch

Nursing Implications
- May be responsible for dosing, bolusing, monitoring, discontinuing epidural
- Verify infusion and dosing
- Tape all ports
- Orders for maintenance
- Narcan available
- No additional pain medications
Spinal Anesthesia

Regional Anesthesia in Children
Excellent potential for post-op pain control
Most commonly performed in the OR under general anesthesia
Anatomic difficulties
Cooperation difficulties

Summary
- Regional anesthesia has its own benefits
- Regional anesthesia has its own risks
- Regional anesthesia has its own implications for care

Questions?

References